Hybrid superprism with low insertion losses and suppressed cross talk

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Cross talk and high insertion losses are issues that need to be resolved to build efficient demultiplexers based on the superprism effect. Here we show that an adiabatic transition inside the photonic crystal (PC) can alleviate the insertion losses, provided the PC boundary is along a crystallographic axis that breaks certain symmetries. Bloch modes located at the sharp features of the equi-frequency contours (EFC) are the most useful for light demultiplexion, but have a complex structure that is difficult to couple to. Inside the adiabatic transition they are projected onto other regions of the EFC that do not feature such difficulties. In this way more than 90% insertion efficiency is demonstrated with 2D FDTD.

Furthermore, beam broadening inside the PC limits the resolution of superprisms. We show that positive refraction in the material prior to the PC can compensate negative refraction inside the PC so that refocused beams are obtained at the output edge of the crystal. In such a way beam broadening inside the PC is compensated and cross talk is suppressed. 60 nm resolution is obtained with a 27 μm wide PC (2D FDTD). The resolution is shown to scale directly with the size of the PC *in this design*.